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OPERATION AND CONSTRUCTION OF RADIO ALTIMETER

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The altitude of an aircraft is still being determined by the traditional barometric method; however, this method has many faults. On the negative side are errors resulting from the estimated calculation of temperature and atmospheric pressure on the earth's surface at the spot where the measurements are taken, the inability to determine precisely the altitude of topographic features below the aircraft at various altitudes, etc.

In this connection, altimeters have been constructed to measure directly the relative altitude of the aircraft in flight, independently of pressure and other atmospheric conditions. In this class belong acoustical, optical, and radio altimeters.

The most important of these, from a flight standpoint, is the radio altimeter for low altitudes ranging from zero to 1,200 meters (see appended figure).

Principle of Operation of Radio Altimeter for Low Altitudes

The basic elements of the altimeter are the transmitter and the receiver. The transmitter constantly emits electromagnetic impulses at frequencies varying continuously from 400 to 440 megacycles.

Throughout the whole period of operation, the transmitter, by means of the transmitting antenna, sends to the ground signals of a definite frequency. These signals are reflected from the ground and reach the receiver via the receiving antenna.

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Simultaneously, in addition to the signals reflected by the earth, the tuned circuit of the receiver receives signals directly from the transmitter.

Because of the fact that the distance traveled by the reflected signal is longer than that covered by the direct signal, the reflected signal reaches the receiving antenna with a certain time lag, which causes a difference between the frequencies of the two signals. When the direct signal and the reflected signal are combined, beats result and a corresponding voltage is set up in the antenna of the receiver.

The current corresponding to the beat frequency is then amplified in the amplifier of the receiver and conducted to the frequency meter, where it is converted into direct current having a voltage directly proportional to the beat frequency. The direct current is transmitted to the indicator of the altimeter and causes a displacement of the indicator hand.

Inasmuch as both the beat frequency and the voltage are directly proportional to the altitude, the altimeter can be calibrated in meters.

Construction of Radio Altimeter for Low Altitudes

The altimeter consists of the transmitters, the transmitting antenna, the receiver, the receiving antenna, the power source and the indicator.

The transmitter, receiver, and the power source are located in the cockpit; the receiving and transmitting antennas are placed under the wings or under the fuselage 2 - 3 meters apart. The indicator is built into the instrument panel.

To increase the precision of altitude readings, two scales are used on the indicator: from 0 to 120 meters and from 0 to 1,200 meters. Commutation from one scale to the other is by means of the commutator placed on the indicator.

The altimeter takes its power from the plane's 26-volt circuit. The weight of the equipment (without cables) is 12 kilograms.

Readings of the Altimeter in Flight

The radio altimeter always measures the shortest distance between the surface of the earth and the aircraft. When the aircraft is climbing, the indicator hand moves in the direction of the higher readings in conformity with the increasing altitude. At an altitude of over 120 meters, it comes to a stop at the right end of the scale.

When the aircraft continues to climb to an altitude exceeding 250 to 300 meters, the indicator hand starts to fall and may reach zero as a result of the fading of the reflected signal.

Although the equipment does not give faulty results at altitudes exceeding the limits of the first scale, nevertheless, when the altitude exceeds 120 meters, it is necessary to pass over to the second scale. When the aircraft is flying at an altitude exceeding the range of the second scale, at first the indicator hand stays at the right end of the scale, and upon continued ascent drops as a result of the fading of the reflected signals.

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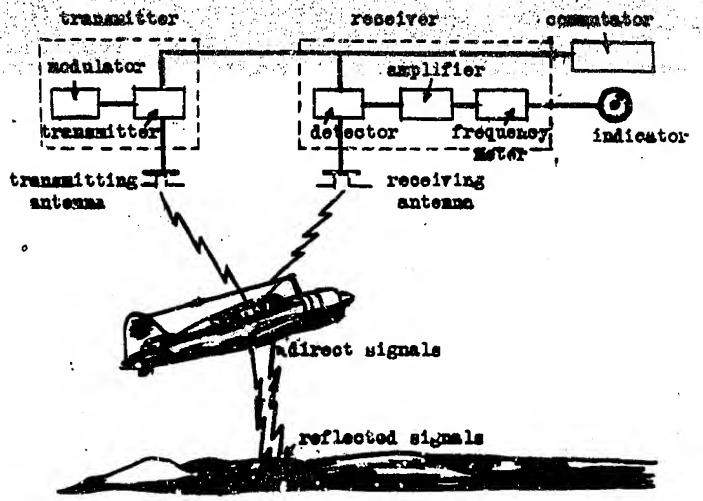
During long flights at altitudes exceeding the range of the second scale, the altimeter should b disconnected. During flight over uneven terrain, the indicator of the altimeter may be observed to oscillate, conforming to the altitude of objects on the terrain (elevations, ravines, mountains, buildings, etc.). During flight over a forest, the instrument indicates the distance between the ground nd the aircraft. If the forest is very dense and leafy, the instrument indicates the altitude not from the ground but from the leafy boughs of the trees.

The instrument does not react to elevation ahead of the aircraft. In flight over steep mountains with sharp peaks, the instrument indicates the altitude of the aircraft measured not from the summit of the mountain, but from the slope. The readings of the instrument become faulty and cannot be used.

In steep turns, the readings of the altimeter are unsteady and inaccurate.

Use of the radio altimeter at low altitudes in airforce units of the Soviet Army has proved that, in conjunction with other navigation and radio-navigation instruments, it can be applied successfully for instrument flying, for penetrating a low ceiling and for instrument landings.



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